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(56) Documents cited

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(54) Fuel-conveying system

(57) A fuel-conveying system comprises a cannister (1) insertable into a fuel tank through the roof (20) thereof. The cannister has an upper cover (2) and depending therefrom a container (3) which houses an electrically driven pump (7) which sucks fuel from an intermediate chamber (4) situated under the container bottom wall, which itself has a drain aperture. The floor of the intermediate chamber is a separation wall in the form of a fine-mesh filter. The interior of the container is charged with fuel, even when the fuel in the tank loses contact with the separation wall during cornering, by return flow of fuel from the consumer supplied to the container directly, or by way of the intermediate chamber.

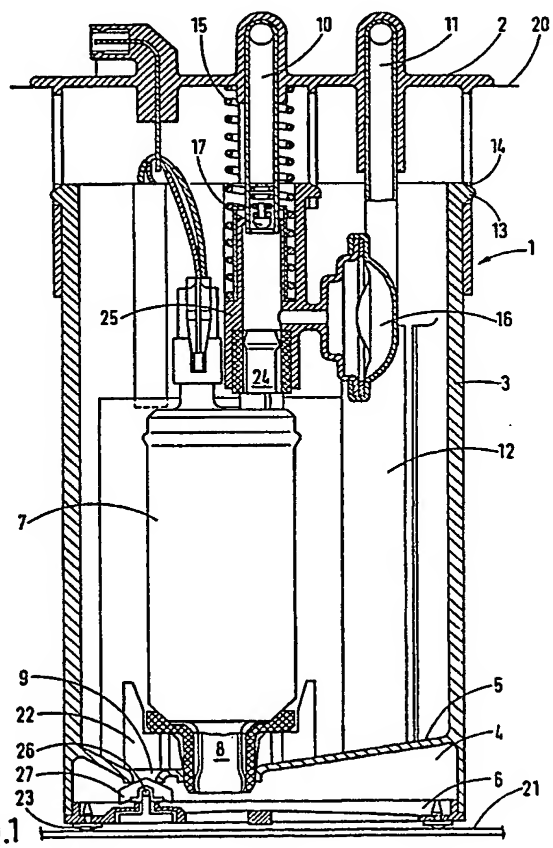

Fig.1

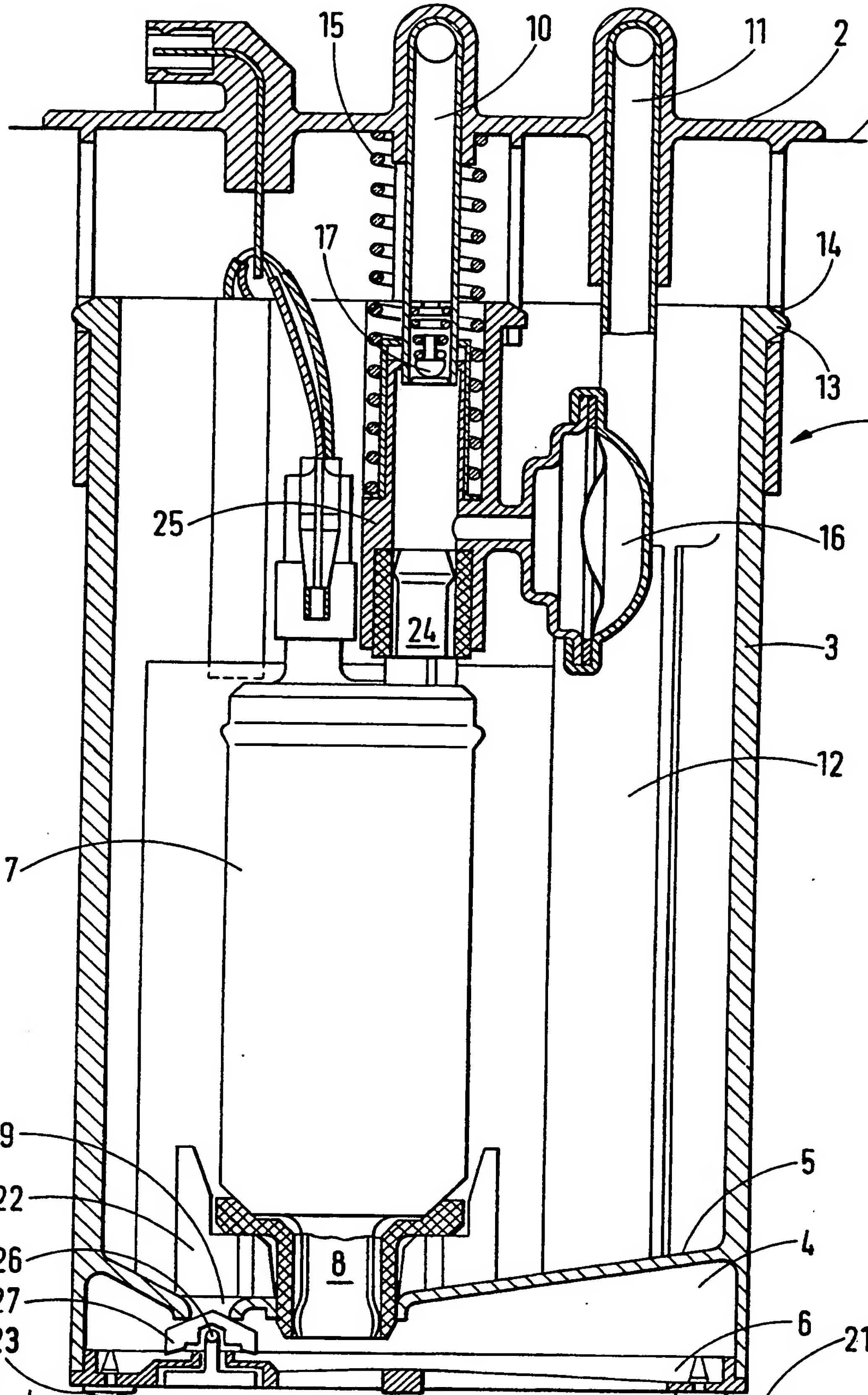

Fig.1

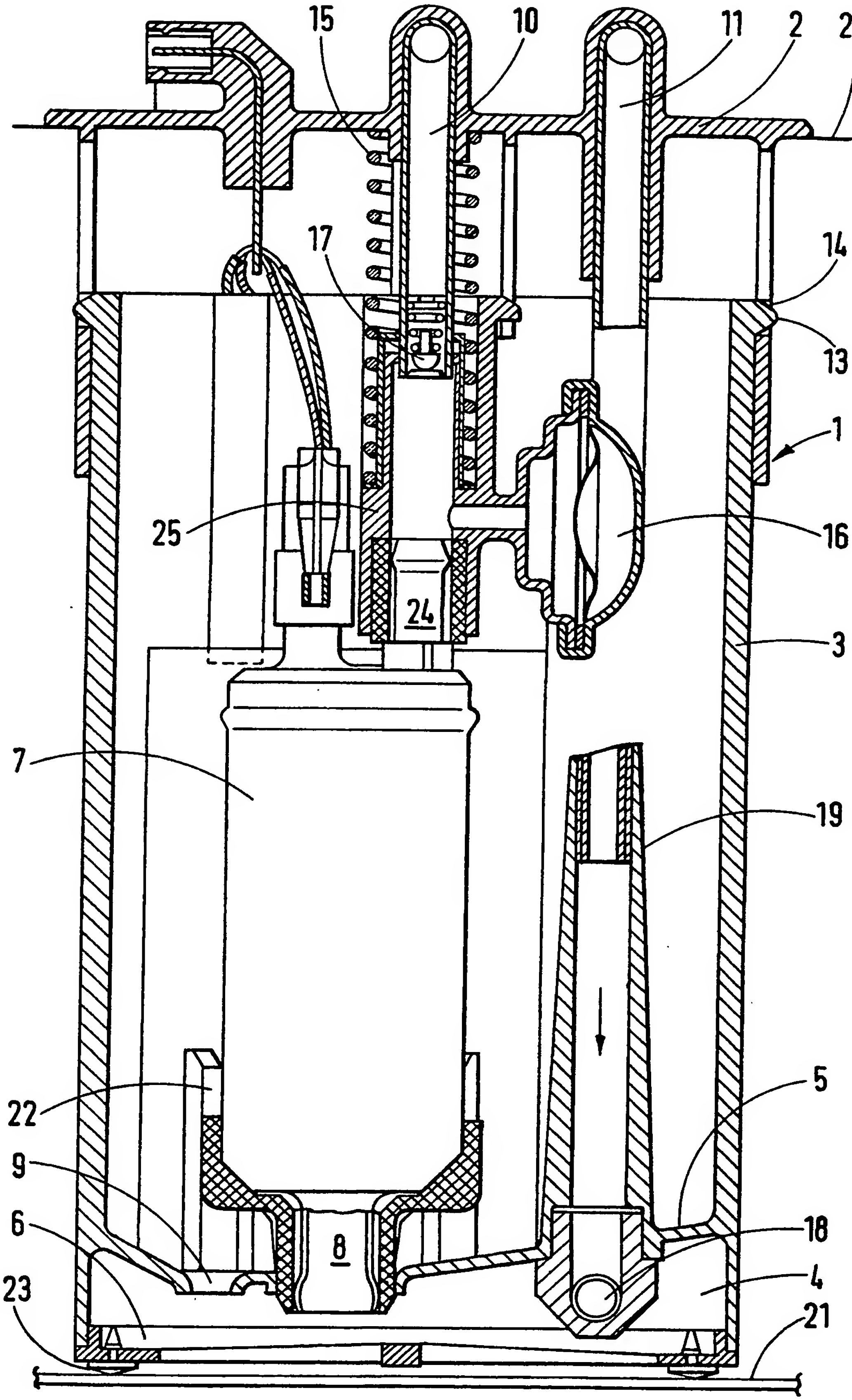

Fig.2

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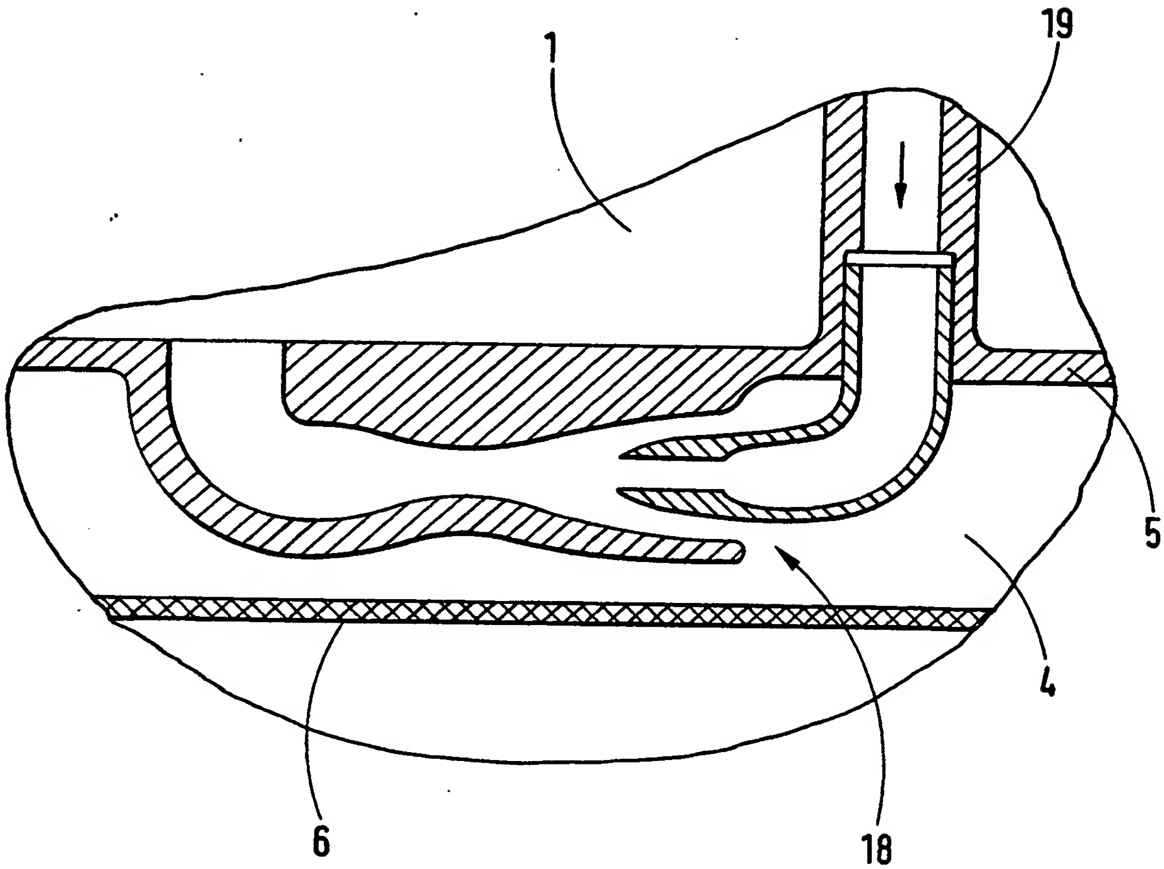

Fig.3

SPECIFICATION

Fuel-conveying system

The invention relates to a fuel-conveying system.

Electrically driven fuel pumps, particularly those used for supplying fuel to the fuel-injection systems of internal combustion engines, must supply a flow of fuel continually, without interruption, under all the varied operating conditions which the vehicle might encounter. Comparatively severe problems can arise when the vehicle is coming around a bend in the road with the fuel tank nearly empty. Under these circumstances the fuel in the tank of the vehicle is sloshed sideways by the centrifugal effect and, if there is little left in the tank, a problem arises in ensuring that an adequate supply of fuel continues to reach the inlet connection of the pump.

In attempting to solve this problem a pot has been installed in the fuel tank of the vehicle. The interior of the pot communicates with the body of fuel in the tank through passages as small in diameter as possible but sufficient to maintain a liquid level in the pot the same as the liquid level in the tank. The fuel pump sucks fuel from the interior of the pot. Excess fuel delivered by the pump, i.e. what is not consumed by the engine, is returned to the pot. A disadvantage of this arrangement is that the liquid level in the pot can never be higher than the liquid level in the tank, which can be very low when the tank is nearly empty. In further development of the idea transverse channels have been installed in the tank of the vehicle, equipped with flap-valves and arranged so that when the vehicle comes around a bend in the road the fuel in the transverse channel nearer the inside of the bend flows through the open flap-valve into the pot whereas the fuel in the channel nearer the outside of the bend is retained by the closed flap-valve. A disadvantage of this arrangement is the high construction and installation costs.

The intention in the present invention is to obviate these disadvantages by providing a fuel-conveying system which costs comparatively little to construct and install but which nevertheless ensures the most continuous and adequate possible supply of fuel to the electrically driven fuel pump.

The problem is solved, according to the invention, by providing a fuel-conveying system comprising a cannister consisting of an upper cover and a container; the container being installed in a tank by lowering it through an opening in the ceiling of the tank, the container extending downwards as far as the floor of the tank; the container containing an electrically driven fuel pump whose outlet connection communicates with a fuel-delivery channel leading to a consumer;

and wherein the lower part of the container has an intermediate chamber communicating with the suction inlet of the fuel pump; a return-flow channel leading from the consumer, communicating with said container, either directly, or by way of said intermediate chamber.

Further advantageous developments are described in the subsidiary claims.

The invention makes it possible to obtain the following advantages:

-It is not necessary to use a two-stage pump for conveying fuel from the tank into the pot and from there to the engine.

-There is a general improvement in pumping efficiency.

-The costs of manufacture and installation are reduced.

-The fuel in the tank is warmed only minimally.

-Gas bubbles are separated from the liquid fuel.

Further characteristics of the invention will now be described with the help of the drawings, which show two preferred but non-limiting examples of the invention. In the drawings the same constructional parts have been given the same reference numbes. In the drawings:-

Figure 1 shows a first example of the fuel-conveying system of the invention.

Figure 2 shows a second example.

Figure 3 is a cross-sectional showing of a detail of the example of Figure 2.

The fuel-conveying system illustrated in Figure 1 comprises a cannister 1 consisting of an upper cover 2 and a lower container 3. The cannister 1 is installed in a fuel tank whose ceiling indicated in the drawing at 20, the cannister being introduced into the fuel tank 20 through an upper opening. The cannister 1 reaches all the way down to the tank floor 21. In order to allow for tanks of different depths, the two parts 2 and 3 of the cannister 1 telescope together, secured in place by catch-noses 13 on the container 3, which engage in openings 14 in the cover 2. The container 3 has a bottom wall 5 supporting, by a bracket holder 22, an electric fuel pump 7 having an suction inlet 8.

The outlet connection 24 of the pump 7 is connected, through a connecting piece 25, to an outlet channel 10 through which fuel is delivered to the consumer, i.e. the internal combustion engine of a vehicle. The connecting piece 25 can, if desired, be equipped with a damper 16, to absorb pressure surges, and has a non-return valve 17. The connecting piece 25 is thrust downwards resiliently by a compression spring 15, which takes support at its upper end against the cover 2, the compression spring 15 thrusting the container 3 resiliently downwards, relative to the cover 2, so that the base of the container 3 rests firmly in contact, by its support feet 23, with the tank floor 21 in spite of dimensional tolerances in the manufacture of the tank, which can, for example, be made of a plastics material.

The container 3 in the version shown in Figure 1, houses a separate chamber 12 which receives fuel returned from the consumer, arriving through a return-flow channel 11. The separate chamber 12 has a slot extending all the way from its upper end to its lower and the slot allowing gas bubbles to escape from the chamber 12, i.e. the slot separates the gas bubbles from the liquid fuel. This is to prevent gas bubbles from reaching a drain aperture 9 in the container bottom wall 5. The method of functioning of the drain aperture 9 will be de-

scribed further below. The drain aperture 9 is opened and closed in the version of Figure 1, by a float-controlled valve 27, whose float is shown at 26.

The fact that the fuel returned through the return-flow channel 11 flows into the separate chamber 12 has the advantage that the heat in this stream of fuel, which is excess fuel not consumed by the engine, remains for a short time at least, within the cannister 1 and cannot immediately reach the fuel tank 20.

According to an essential feature of the invention, situated below the bottom wall 5 of the container 3, there is an intermediate chamber 4 whose floor is a separation wall 6 in the form of a fine-mesh filter having filtering apertures of diameters between 40 and 100 microns, preferably between 50 and 80 microns. The suction inlet 8 of the pump 7 penetrates downwards through a bore in the container bottom wall 5, near the drain aperture 9, and communicates with the intermediate chamber 4, so that the pump draws all its fuel from the intermediate chamber 4.

The example of the fuel-conveying system of the invention shown in Figure 1, functions as follow:

Let it be assumed that the separation wall 6, which is in the form of a fine-mesh filter, is in contact with the fuel in the tank 20. Under these circumstances the fuel pump 7 sucks fuel through the filter, i.e. through the separation wall 6, from the tank 20. The float-controlled valve 27 is held closed by the fact that the float 26 is thrust buoyantly upwards by the fuel. The drain aperture 9 is therefore, under these circumstances, closed. Nevertheless, it should be observed that the drain aperture 9 is so dimensioned that even when the float-controlled valve 27 is open, for example due to a low level of fuel in the tank 20, the rate of the flow of fuel from the container 3 into the intermediate chamber 4, through the draim aperture 9, is always less than the rate of the flow of fuel returned to the cannister 1 through the return-flow channel 11. This tends to ensure that the cannister 1 always contains an adequate reserve of fuel.

Supposing now that the vehicle, coming around a bend in the road, sloshes the fuel sideways, by the centrifugal effect, so that the fuel in the tank 20 is no longer in contact with the filter, i.e. with the separation will 6. The float-controlled valve 27 opens, allowing fuel to flow from the container 3 through the drain aperture 9 into the intermediate chamber 4, from where it is sucked upwards by the fuel pump 7 and delivered through the delivery channel 10.

Due to the suction created by the pump 7 in the intermediate chamber 4, no fuel flows back through the filter into the tank 20. Furthermore the filter, due to the surface tension of the fuel in its small-diameter filtering apertures, acts like a separation wall, preventing air from the partly empty fuel tank 20 from entering the intermediate chamber 4.

The suction created by the pump 7 in the intermediate chamber 4, which is influenced by the flow resistance through the drain aperture 9, must not exceed the surface tension in the filtering apertures of the filter constituting the separation wall 6. Consequently the pump 7 must be dimensioned so that this limiting suction is not exceeded. And both the total filter area and the diameter of the filtering apertures must be selected so that the permissable suction in the intermediate chamber 4 is not exceeded.

Figure 2 shows a second version of the fuel-conveying system of the invention. In this version, instead of the slotted separate chamber 12 in the container 3, the intermediate chamber 4 contains an injector nozzle 18, for example as shown in Figure 3, whose inlet is connected through a connecting piece 19 to the return-flow channel 11. The returned fuel flowing through the injector nozzle 18 sucks fuel from the intermediate chamber 4 and discharges it to the container 3 at a location above the bottom wall 5, increasing the quantity of fuel in the container 3.

Both these examples of the fuel-conveying system of the invention are outstandingly simple in construction, and each can be installed easily in the fuel tank. The gap between the filter and the tank bottom wall is always the same, irrespective of tolerances in the dimensions of the tank, and remains unchanged even when the tank bottom shifts in position.

CLAIMS

1. A fuel-conveying system comprising a cannister consisting of an upper cover and a container; the cannister being installed in a tank by lowering it through an opening in the ceiling of the tank, the container extending downwards as far as the floor of the tank; the container containing an electrically driven fuel pump whose outlet connection communicates with a fuel-delivery channel leading to a consumer;

and wherein the lower part of the container has an intermediate chamber communicating with the suction inlet of the fuel pump; a return-flow channel leading from the consumer, communicating with said container, either directly, or by way of said intermediate chamber.

2. Fuel-conveying system as claimed in Claim 1, characterised in that the intermediate chamber is bounded at the top by the solid bottom wall of the container and has, as its floor, a separation wall, the pump drawing its fuel only from the intermediate chamber.

3. Fuel-conveying system as claimed in Claims 1 or 2, characterised in that the separation wall is in the form of a fine-mesh filter.

4. Fuel-conveying system as claimed in Claim 3, characterised in that the fine-mesh filter has filtering apertures of diameters between 40 and 100 microns, preferably between 50 and 80 microns.

5. Fuel-conveying system as claimed in Claim 2, characterised in that the bottom wall of the container has a drain aperture leading from the interior of the container to the intermediate chamber.

6. Fuel-conveying system as claimed in Claim 5, characterised in that the drain aperture is so di-

mensioned that the fuel is drained off at a lesser rate of flow than that of the fuel flowing inwards through the return-flow channel leading from the consumer.

7. Fuel-conveying system as claimed in Claims 5 or 6, characterised in that the drain aperture is so dimensioned that the suction created in the intermediate chamber by the pump is less than the surface tension of the fuel in the filter apertures of a fine-mesh filter constituting the floor of said intermediate chamber.

8. Fuel-conveying system as claimed in one of the Claims 5 to 7, characterised in that the drain aperture in the bottom wall of the container is opened and closed by a float-controlled valve.

9. Fuel-conveying system as claimed in Claim 1, characterised in that the container houses, situated above its bottom wall, a separate chamber communicating with the return-flow channel leading from the consumer.

10. Fuel-conveying system as claimed in Claim 9, characterised in that the separate chamber has a slot extending from the top end to the lower end of its wall, and effective to allow bubbles carried in the fuel in said separate chamber, to escape from the fuel.

11. Fuel-conveying system as claimed in one of the Claims 1 to 8, characterised in that the intermediate chamber contains an injector nozzle whose inlet opening communicates with the return-flow channel leading from the consumer, flow through said nozzle being effective to carry fuel from the intermediate chamber to the interior of the container at a location above its bottom wall.

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